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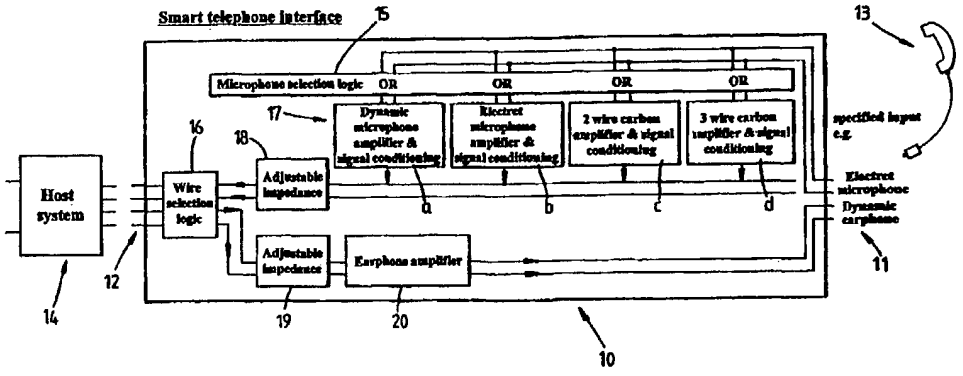

(57) Abstract

The invention provides an interface device for automatically interfacing a natural telephone input device to a telephone host system having an at least 4 wire input/output configured for a specific type of telephone input device comprising an input/output for connection to the telephone host system (14), an input/output for connection to the telephone input device (12), diagnostic circuitry (15) for interrogating the telephone host system (12) to indentify the specific type of telephone input device including testing for DC voltage and detecting current and signal shaping circuitry (b, c and d), responsive to the diagnostic circuitry (15), for shaping the output of the microphone of the actual device so that it appears as if it is a microphone of the specific type.

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Telephone Interface Device

This invention relates to telephone interface devices and, in particular, to interfaces designed to be inserted between a telephone input device and a telephone host system.

For the purposes of this specification the term "telephone input device" includes any device, such as a handset or headset, which includes a microphone (or equivalent device) for delivering speech or other input signals to the telephone host system and a earphone (or equivalent arrangement) for delivering sound signals to a user. Thus it includes a set up, for example, in which sound or other output signals are delivered to an inductive loop and are picked up by a earpiece such as a hearing aid and also arrangements where a remote speaker is used, for example, in a hands free phone or there is a visual display as for example, used by the hard of hearing.

Historically, over the years, a variety of telephone host systems have been developed and designed and, because of the longevity of such equipment, many different systems exist throughout the world. In almost every case, the telephone host system has been designed for a particular form of microphone e.g. a dynamic microphone, an electret microphone, a 2 wire carbon microphone or a 3 wire carbon microphone. The various types of microphone produce different outputs and one cannot simply, for example, plug in an electret microphone into a system designed for a 2

wire carbon microphone. Telephone installations typically use 4 wires to connect a telephone input device to the host system. The host may include a domestic telephone or a PBX switchboard at a call centre. These 4 wires may be configured in a variety of ways and the applicable connections depend on the microphone technology of the host system.

In general the arrangements are more earphone tolerant, as long as the earphones are connected to the appropriate wires.

Table 1 shows some of the connection configurations that are possible between the host system and a telephone input device. However, it should be understood that other combinations can exist both in wiring and microphone technology. In addition, there are further variations in input and output impedance and the sensitivity of the host system and these are illustrated in Table 2.

Currently telephone input devices are interfaced to the host system by interface boxes with manual adjustments including mechanical switches. The interface box is configured by a trained engineer who has an expert knowledge of the host, either from taking measurements or from information provided by the telephone input device manufacturer. An untrained user cannot simply plug in an alternative device without this skill or knowledge.

From one aspect the invention consists in an interface device for automatically interfacing an actual telephone input device to a telephone host system having an at least

four wire input/output configures for a specific type of telephone input device comprising, an input/output for connection to the telephone host system, an input/output for connection to the telephone input device, diagnostic circuitry for interrogating the telephone host system to identify the specific type of telephone input device including testing for D.C. voltage and detecting current and signal shaping circuitry, responsive to the diagnostic circuitry, for shaping the output of the microphone of the actual device so that it appears as if it is a microphone of the specific type.

The signal shaping circuitry may include separate circuits for a plurality of types of telephone input device and the diagnostic circuitry may select the separate circuit corresponding to the specific type. The separate circuits may be configured to shape the output of a specific microphone specification or type, in which case only a single input/output may be provided. Alternatively there may be a plurality of such inputs/outputs, each being specific to a particular microphone specification or type. Alternatively the input may be provided with means for reading a coding on the plug of the telephone input device, such as a bar code, or diagnostic circuitry may be provided for determining the type of the actual telephone input device and for controlling the signal shaping circuitry accordingly.

The first mentioned diagnostic circuitry may further include means for diagnosing and effecting the appropriate

connections between the telephone host system and the actual telephone input device.

Means may be provided for inputting a diagnostic protocol to the diagnostic circuitry, for example the device may include an auto-dial facility for dialling a diagnostic protocol data base.

The first mentioned diagnostic circuitry may operate the following diagnostic protocol:

(i) Identify the wires in the input/output for connection the host.

(ii) Test all the wires in pairs for D.C. voltage.

(iii) If no D.C. voltage is found the microphone of the specific type of telephone input device is dynamic.

(iv) If D.C. voltage is detected, then determine if the D.C. negative is common with a earphone wire. If it is then the microphone of the specific telephone input device is 3 wire-carbon, if not then the microphone of the specific telephone input is 2 wire carbon or electret.

(v) If 2 wire carbon or electret microphone is identified connect a pre-determined resistor across the identified microphone wires and detect the current, if it exceeds a pre-calculated level then the microphone is 2 wire carbon, if it is below the level the microphone is electret.

The first mentioned diagnostic circuitry may include means for determining the impedance of the telephone host and/or the earphone or the like of the actual telephone input device and for matching the impedance between the actual telephone input device and the telephone host. Both the first and second diagnostic circuitry may be configured in a single circuit or the tasks may be shared differently from as set out above. Circuitry may be in the form of a pre-programmed chip or a programmable processor may be provided, which can be programmed from an external data base as set out above.

The interface device may also include certain manual controls, but these should be kept to a minimum. The most likely manual control is a volume control, but with the efficient impedance matching achieved by the device, this may be less necessary than heretofore. Alternatively an automatic volume control may be incorporated.

Although the invention has been defined above it is to be understood it includes any inventive combination of the features set out above or in the following description.

The invention may be performed in various ways and this specific embodiment will now be described, by way of example, with reference to the accompanying drawing, which is a schematic view of an interface device. Thus an interface device 10 has a telephone input device input/output 11 and a telephone host system input/output 12 for respective connection to a telephone input device 13 and a telephone host system 14.

The apparatus further includes diagnostic circuitry 15, which integrates the host in accordance with a diagnostic protocol as explained in more detail below. This circuitry 15 determines the specific type of microphone for which the host system 14 has been designed and selects an appropriate one of signal shaping circuits ie, b, c and d in accordance with the specific type of telephone input device detected. Further diagnostic circuitry is provided at 16, which determines the appropriate wire connections at the input/output 12 and is further arranged to adjust the impedance by altering adjustable impedances 18 and 19 for the microphone and earphone respectively of the telephone input device 13. An earphone amplifier 20 is also provided.

The preferred diagnostic protocol to be followed by the logic circuitry 15, 16 is as follows:

1. **Earphone connection** - The host will typically have provision for a wire dynamic earphone. Optimum connection is therefore to (a) select the correct pair of wires and (b) adjust output impedance of the earphone amplifier.

(a) Wire Selection - Select wires in pairs and test for presence of a dialling tone, this will be an A.C. voltage.

Total of 6 choices from 4 wires.

(b) Measure impedance between these identified wires

(i) Measure open circuit voltage.

(ii) Connect a resistor across the pair of wires and adjust its value until the voltage has

been reduced by half.

Earphone wires identified: set the output of the earphone amplifier to that identified in 1(b).

2. **Microphone connection** - For a modern installation the host system will usually be configured for an electret microphone (i.e. 2 wire with low current D.C. supply) but test will be made for other possibilities.

(a) Test all pairs of wires for D.C. voltage (6 choices from 4

If no D.C. voltage - Select the pair of wires that are not identified as the earphone wires. Apply 5mV RMS at 1KHz from variable output impedance source. Adjust output impedance until voltage drops by half.

Microphone is dynamic wires are identified, adjust output impedance of the dynamic microphone amplifier to that identified above.

Test concluded.

If D.C voltage is detected

Is D.C. negative common with an earphone wire? If "yes" then **3-wire carbon** amplifier is required, if not then 2-wire carbon or electret

(I) Test for current.

Connect 1 KOhm resistor between the identified wires.

If current exceeds 20 mA the microphone

amplifier required is 2 or 3 wire carbon.
If current is less than 20 mA the microphone amplifier required is electret.

Microphone technology has been identified appropriate amplifier may be selected.

(II) Test for input impedance.

Make appropriate connections between
'microphone' and 'Common' or
'microphone(+)' and 'microphone(-) or
'microphone' and 'microphone'

Apply 5 mV RMS at 1 KHz from a source of variable output impedance. Adjust output impedance until voltage drops by half. Adjust the appropriate amplifier to this output impedance.

Test concluded

It will be appreciated that other protocols may be possible and that the protocol could be expanded to detect the actual earphone and microphone configuration of the telephone input device 13. In that case the interface device 10 would be very much more flexible, but a greater range of shaping circuits would be needed to allow each possible telephone input device combination to be shaped for each possible telephone host system configuration. It may in those circumstances be desirable to convert the telephone input device input into a digital signal, process it and then re-convert it to the correctly shaped analogue signal

for onward transmission to the telephone host system. It will be noted that the circuit 17 a - d in the specific embodiment also constitute the earphone amplifiers.

The device described above can be used with both analogue and ISDN lines.

Claims

1. An interface device for automatically interfacing an actual telephone input device to a telephone host system having an at least four wire input/output configured for a specific type of telephone input device comprising, an input/output for connection to the telephone host system, an input/output for connection to the telephone input device, diagnostic circuitry for interrogating the telephone host system to identify the specific type of telephone input device including testing for D.C. voltage and detecting current and signal shaping circuitry, responsive to the diagnostic circuitry, for shaping the output of the microphone of the actual device so that it appears as if it is a microphone of the specific type.

2. A device as claimed in claim 1 wherein the signal shaping circuitry includes separate circuits for a plurality of types of telephone input device and the diagnostic circuitry selects the separate circuit corresponding to the specific type.

3. A device as claimed in claim 2 wherein the separate circuits are configured to shape the output of a specific microphone specification or type.

4. A device as claimed in any one of the preceding claims wherein the input/output for the telephone input device is specific to the particular microphone specification or type.

5. A device as claimed in claim 4 wherein the device includes a plurality of specific input/outputs for telephone

input devices.

6. A device as claimed in any one of the preceding claims further including diagnostic circuitry for determining the type of the actual telephone input device and for controlling the signal shaping circuitry accordingly.

7. A device as claimed in any one of the preceding claims wherein the first mentioned diagnostic circuitry further includes means for diagnosing and effecting the appropriate connections between the telephone host system and the actual telephone input device.

8. A device as claimed in any one of the preceding claims including means for inputting a diagnostic protocol to the diagnostic circuitry.

9. A device as claimed in claim 8 wherein the inputting means includes an auto-dial facility for dialling a diagnostic protocol data base.

10. A device as claimed in any one of the preceding claims wherein the first mentioned diagnostic circuitry operates the following diagnostic protocol:

(i) Identify the wires in the input/output for connection to the host.

(ii) Test all the wires in pairs for D.C. voltage.

(iii) If no D.C. voltage is found the microphone of the specific type of telephone input device is dynamic.

(iv) If D.C. voltage is detected, then determine if the D.C. negative is common with a earphone wire. If it is then the microphone

of the specific telephone input device is 3 wire-carbon, if not then the microphone of the specific telephone input is 2 wire or electret.

(v) If 2 wire carbon or electret microphone is identified connect a predetermined resistor across the identified microphone wires and detect the current, if it exceeds a pre-calculated level then the microphone is 2 wire carbon, if it is below the level the microphone is electret.

11. A device as claimed in anyone of the preceding claims, wherein the diagnostic circuitry includes means for determining the impedance of the telephone host and/or the earphone or the like of the actual telephone input device and for matching the impedance between the actual telephone input device and the telephone host.

12. An interfacing device substantially as herein before described with reference to the accompanying drawing.

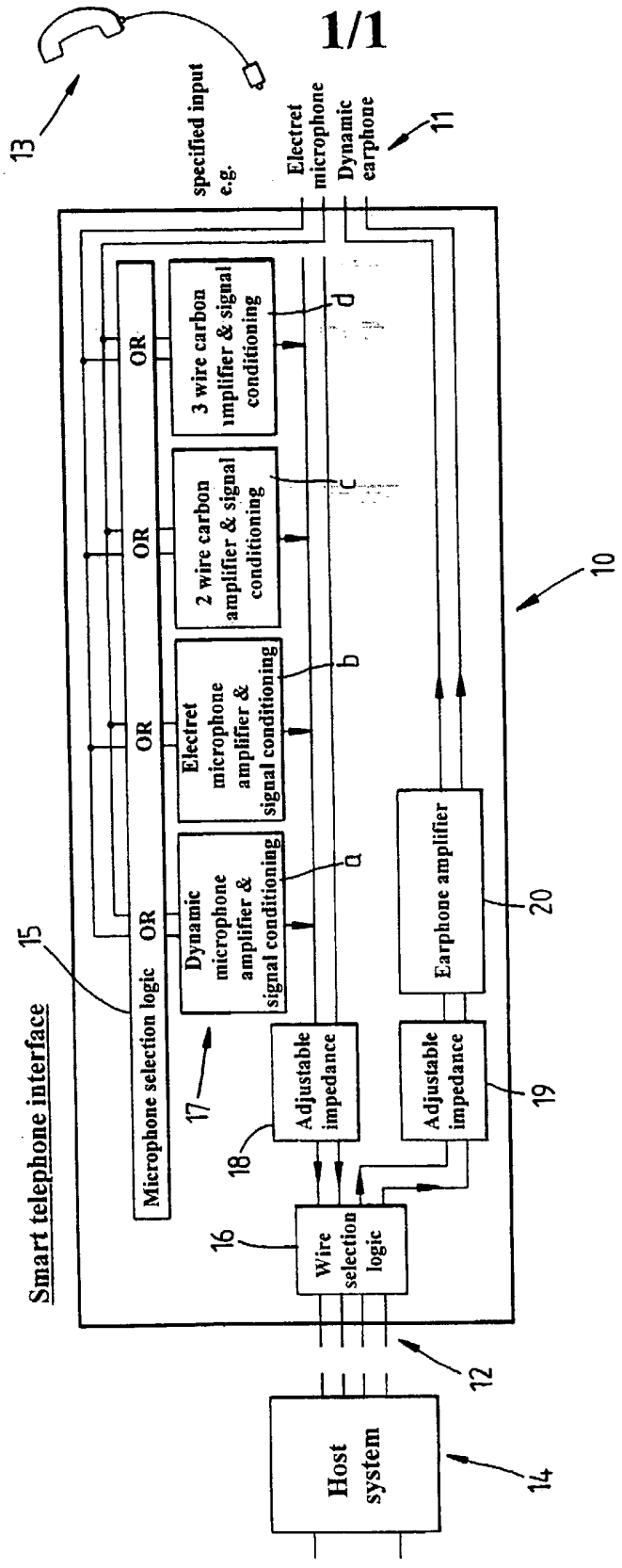
TABLE 1

TYPE	WIRE 1	WIRE 2	WIRE 3	WIRE 4
DYNAMIC	Microphone	Earphone	Earphone	Microphone
DYNAMIC	Earphone	Microphone	Microphone	Earphone
DYNAMIC	Microphone	Microphone	Earphone	Earphone
DYNAMIC	Earphone	Earphone	Microphone	Microphone
ELECTRET	Microphone (-)	Earphone	Earphone	Microphone (+)
ELECTRET	Microphone (+)	Earphone	Earphone	Microphone (-)
2 WIRE CARBON	Microphone	Earphone	Earphone	Microphone
3 WIRE CARBON	Microphone	Common	Earphone	DC (+)

TABLE 2

PARAMETER	CARBON	ELECTRET/ DYNAMIC
Nominal Impedance	50 Ohms	1000 Ohms
Nominal Sensitivity	-6 dBV/Pa	-25 dBV/Pa
Sensitivity Range	+6 to -40 dBr	+15 to 20 dBr
DC Interfacing Range	10 to 100 mA	1.5 to 12 V
Frequency Range	200 Hz to 4 Khz	200 Hz to 4 KHz

1/1


13
specified input
e.g.
Electret microphone
Dynamic earphone
11
10
3 wire carbon amplifier & signal conditioning
d
2 wire carbon amplifier & signal conditioning
c
Electret microphone amplifier & signal conditioning
b
Dynamic microphone amplifier & signal conditioning
a
OR
OR
OR
OR
Microphone selection logic
15
Smart telephone interface
17
Adjustable impedance
18
Adjustable impedance
19
Earphone amplifier
20
16
Wire selection logic
12
Host system
14

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/GB 99/00670

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04M1/60

According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 97 36411 A (HELLO DIRECT INC) 2 October 1997 (1997-10-02)	1-9,11, 12
A	page 2, line 10 - line 20 page 3, line 22 - page 18, line 18; figures 1-9	10

Y	EP 0 459 405 A (PLANTRONICS) 4 December 1991 (1991-12-04) column 1, line 1 - column 10, line 47; figures 1-3	1-9,11, 12

A	US 4 918 726 A (SNYDER) 17 April 1990 (1990-04-17) column 2, line 41 - column 4, line 15; figure 5 column 8, line 20 - column 9, line 51; figures 2,3	1-5,11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 92 12588 A (SCHUH) 23 July 1992 (1992-07-23) page 6, line 1 - line 28; figure 1	1-5,10

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